EEG Artifacts

Course Instructors

Dr. Annushree Bablani

Acknowledgments: Dr. Sreeja S R

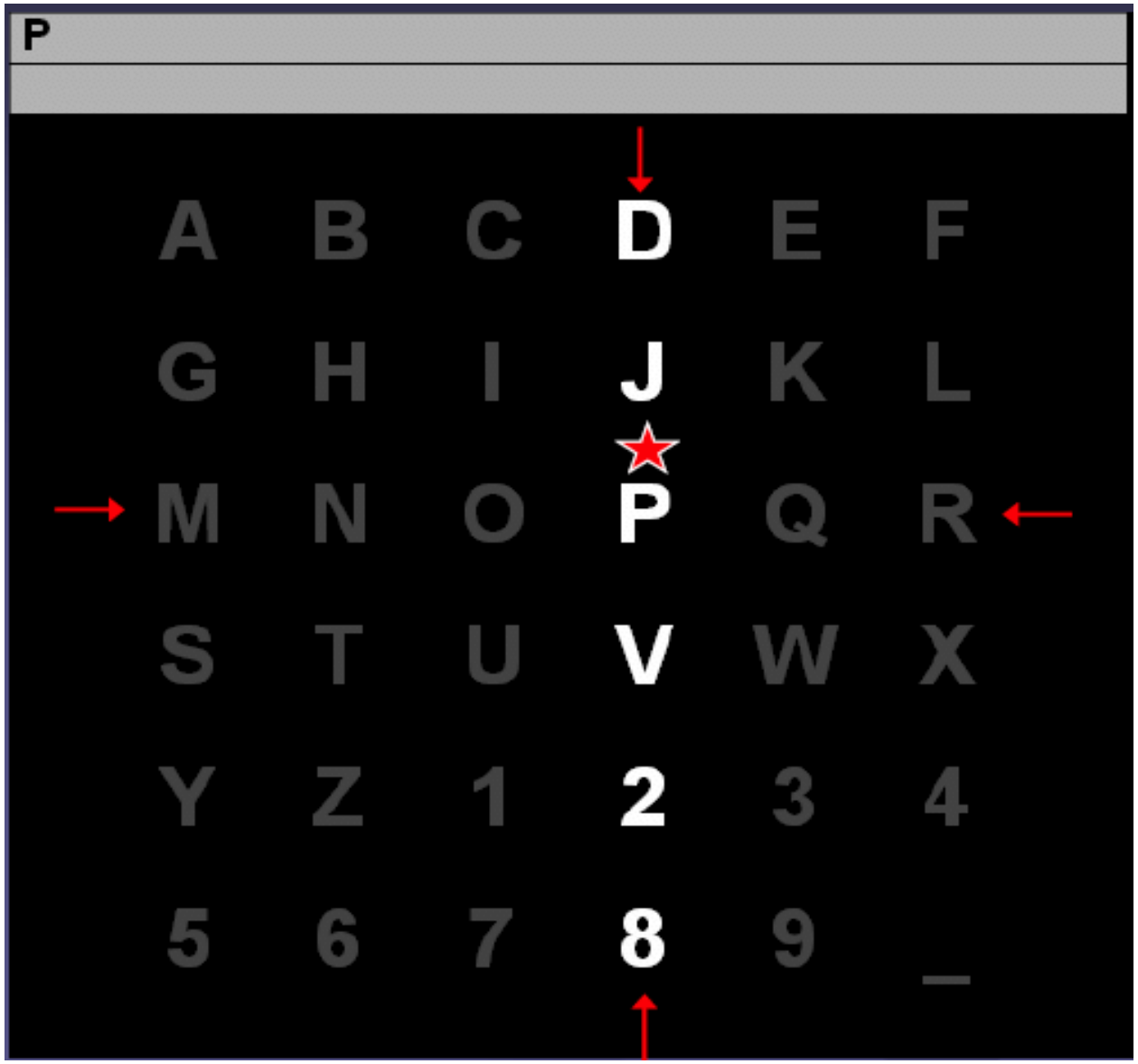
EEG Paradigms

01 P300

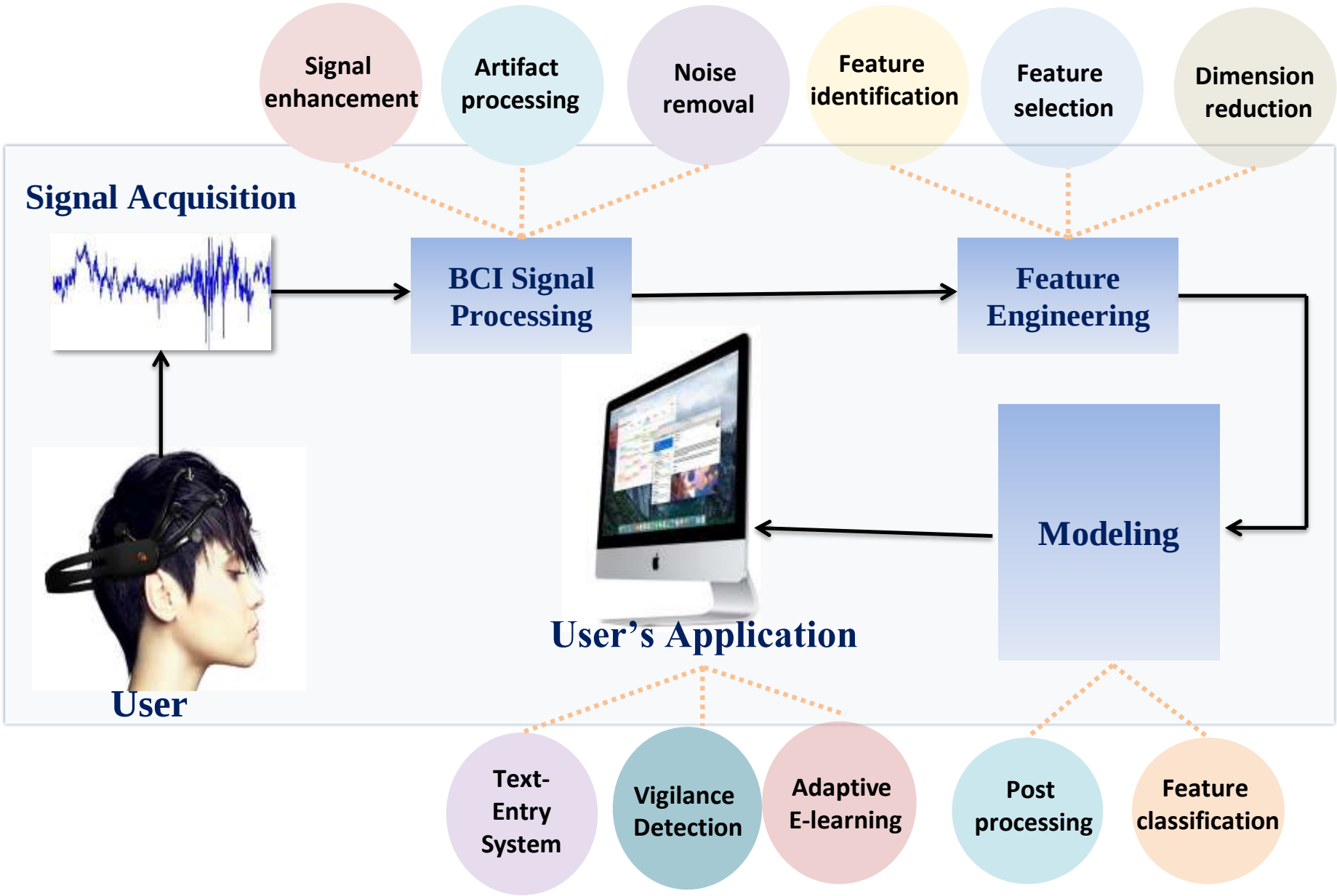
02 SCPs

03 SSVEPs

04 SMRs



EEG based BCI System Development



Recording the EEG

- **EEG electrodes**:
  - Small metal discs usually made of stainless steel, tin, gold or silver covered with a silver chloride coating.
  - They are placed on the scalp in spatial positions using the International 10/20 system.

Fig: EEG cables showing the disc electrodes to which electrode gel is applied and applied to the subject's scalp.

Recording the EEG

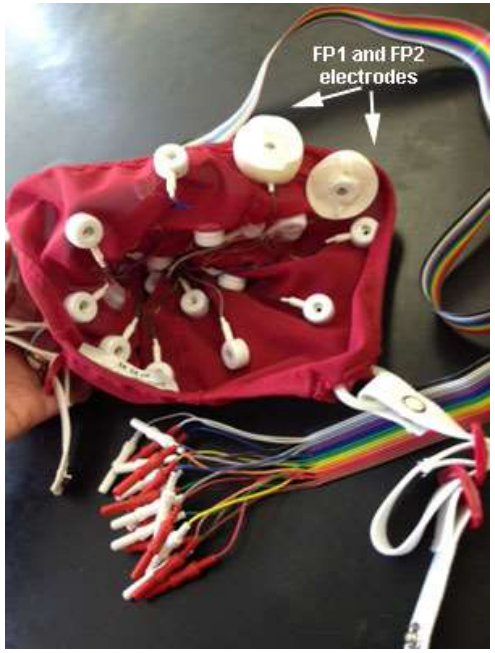


Fig: Many recording systems use a cap into which electrodes are embedded; this facilitates recordings when high density arrays of electrodes are needed or when comparing recording sites. The image to the right shows the inside of such a cap.

Recording the EEG

- **Electrode gel:**
  - It acts as a malleable extension of the electrode, so that the movement of the electrodes cables is less likely to produce artifacts.
  - The gel maximizes skin contact and allows for a low-resistance recording through the skin.
- **Impedance**
  - A measure of the impediment to the flow of alternating current, measured in ohms at a given frequency.
  - Larger numbers mean higher resistance to current flow.
  - The higher the impedance of the electrode, the smaller the amplitude of the EEG signal.
  - In EEG studies, should be at lest 100 ohms or less and no more than 5 kohm.

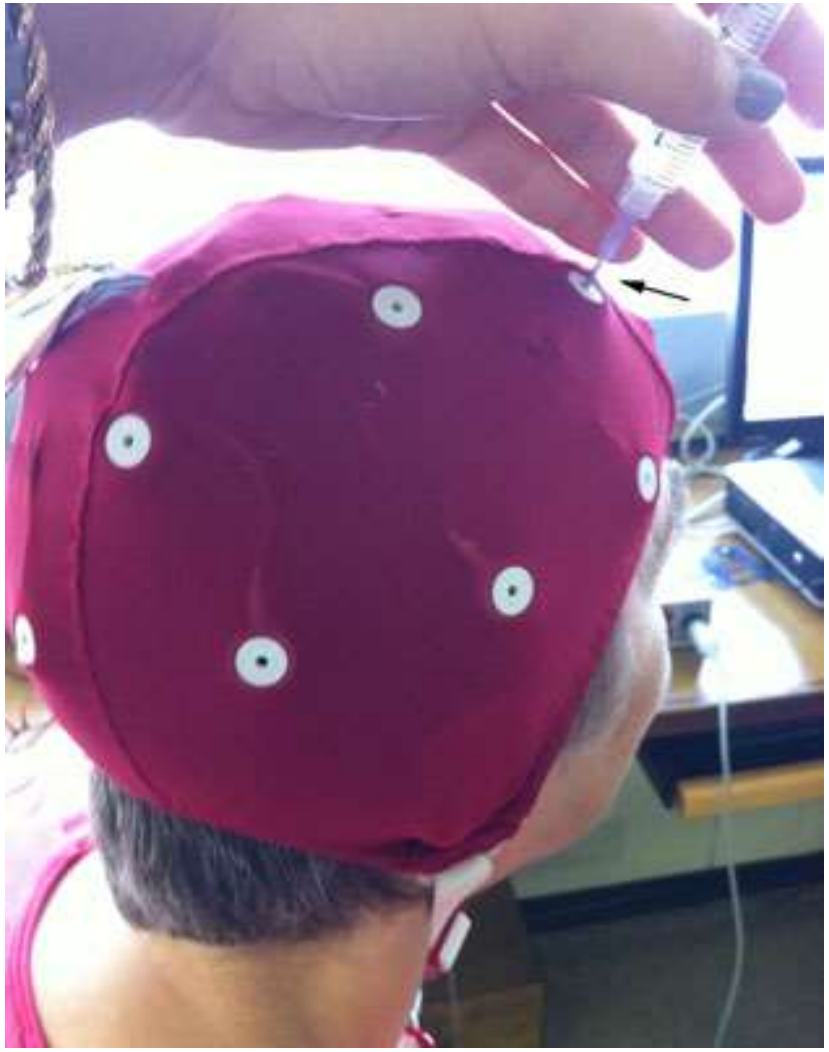


Fig: The electrolytic gel is injected into each cavity until a small amount comes out the hole in the mount. With a moderate amount of downward pressure, the syringe with a blunt needle is rapidly rocked back and forth.

EEG Artifacts

- The electrical artifacts that is not of cerebral origin.
- Anything that is NOT of cerebral origin is termed as **ARTIFACT**
- Physiological and Electrophysiological artifacts.
- Physiological – source (generated other than brain ie. Body)
- Electrophysiological – arise outside the body - equipment and environment
- Some readily distinguished, others closely resemble cerebral activity.

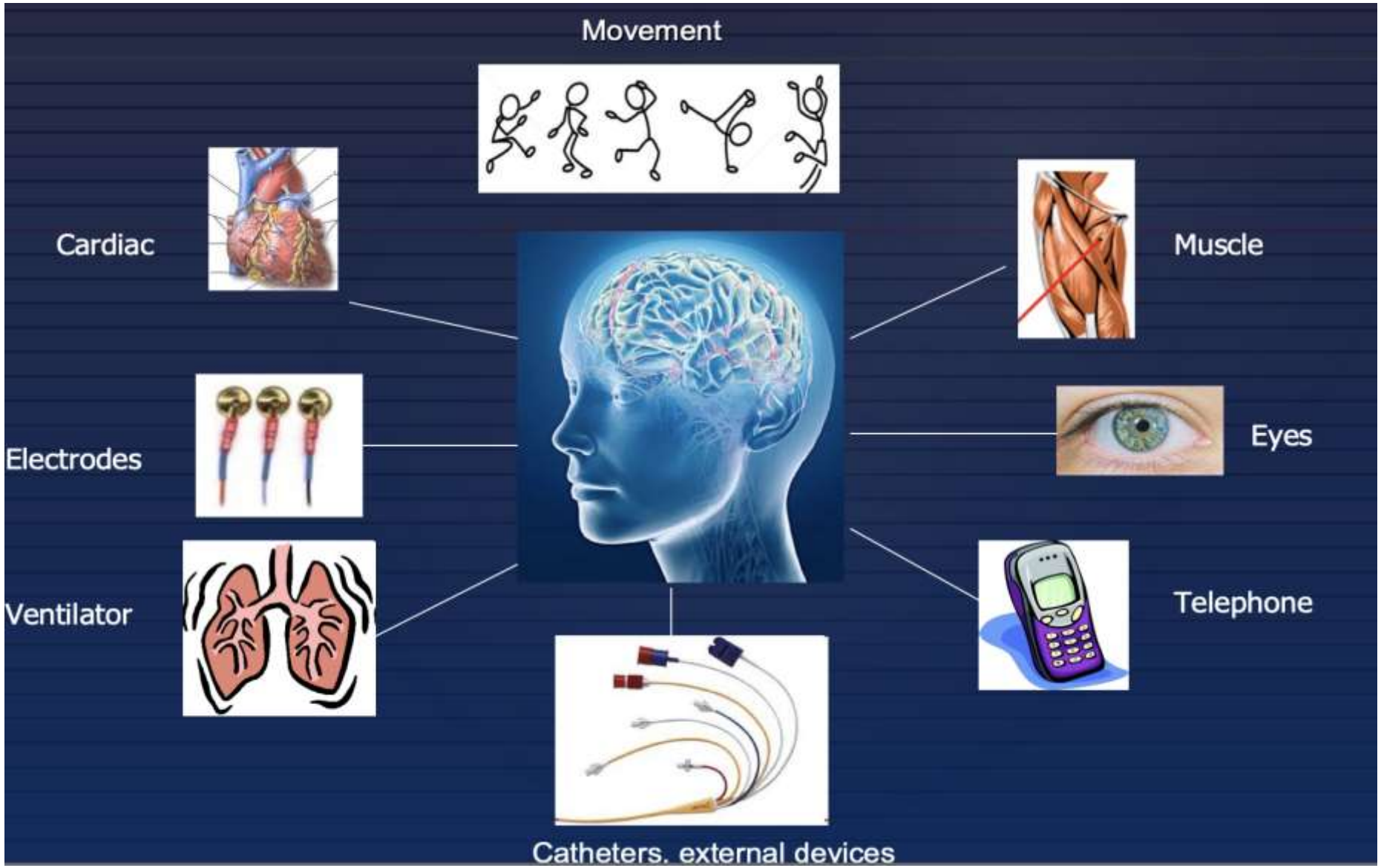
Principles to discriminate artifacts from EEG signals

- Physiological activity has a logical topographic field of distribution with an excepted fall of the voltage potentials
- Artifact have an illogical distribution that defies the principles of localization

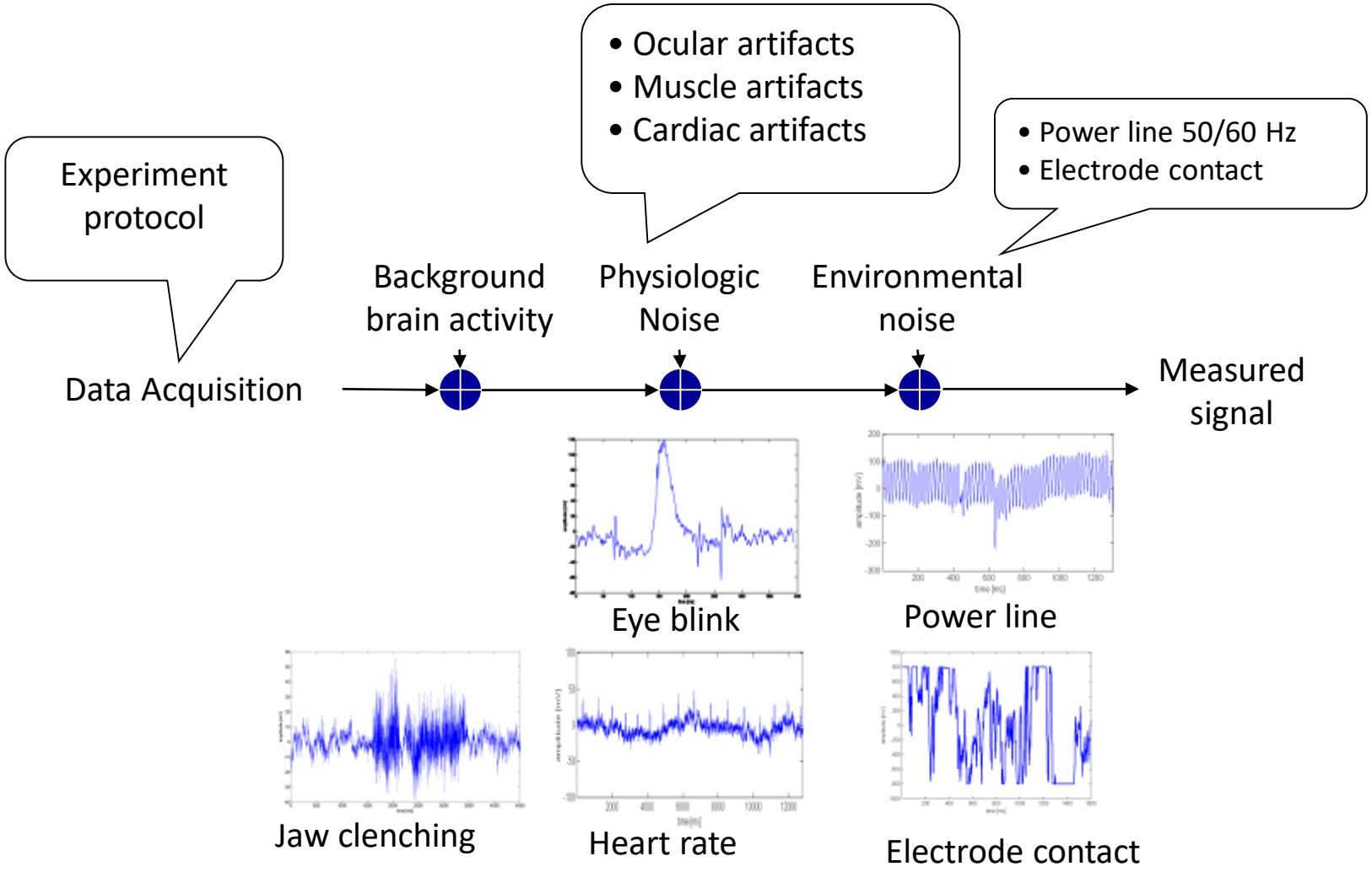
KEY TO AN ARTIFACT FREE RECORDING

- Good, clean preparation
- Good hook-up, neatly bundled electrodes
- Place jack-box close to patients head
- Keep the subject cool, not cold
- Unplug all electrical items close to patient, i.e. bed, radio, fan, etc.

EEG Artifacts

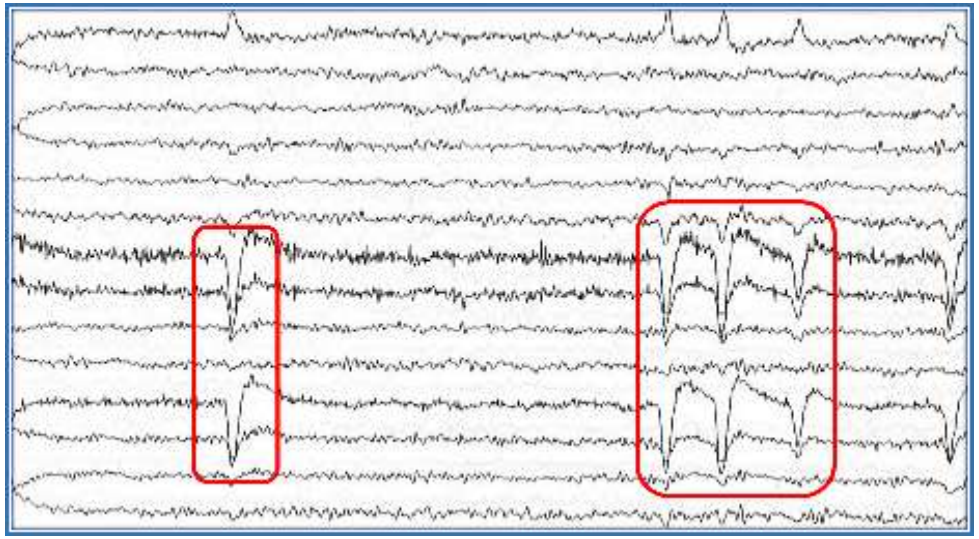


Captured EEG Signal

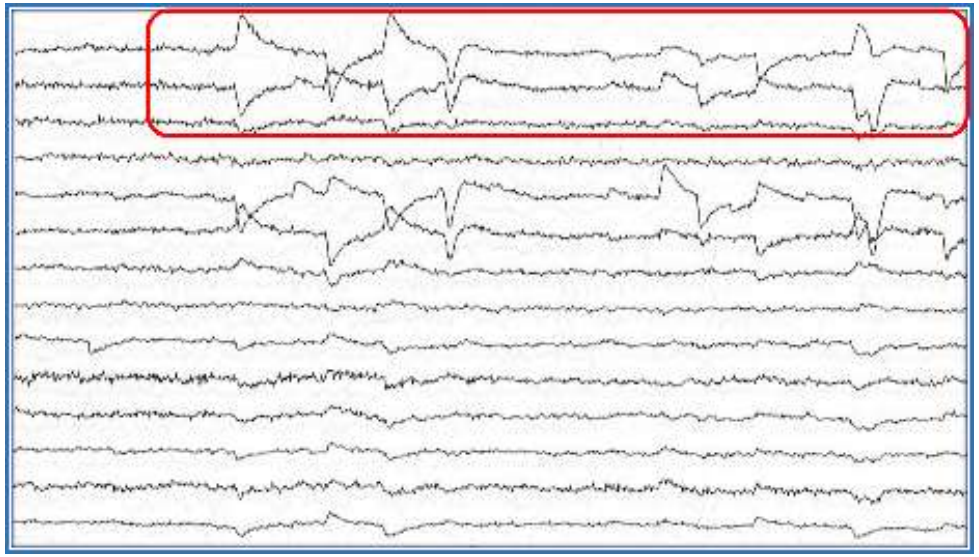


Ocular Artifacts

- Blinks
- Eye flutter
- Lateral gaze
- Slow/roving eye movement
- Rapid eye movement
- Electroretinogram (ERG)



Blink



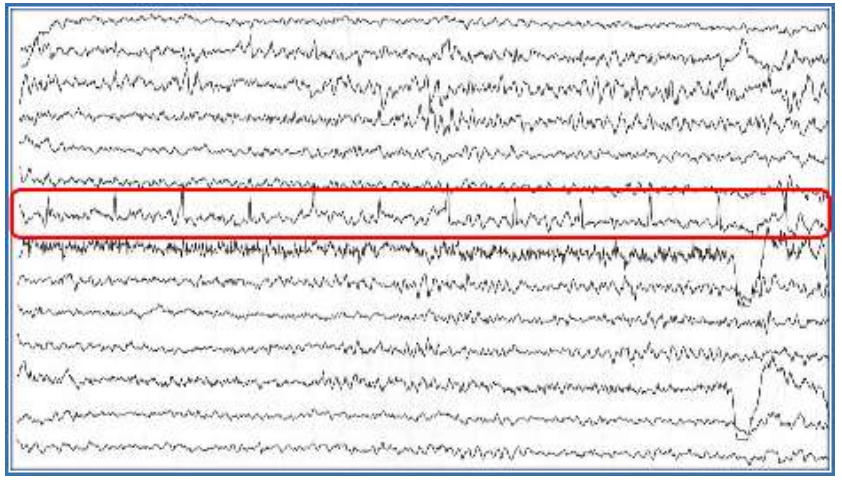
Lateral Eye Movement

Cardiac Artifacts

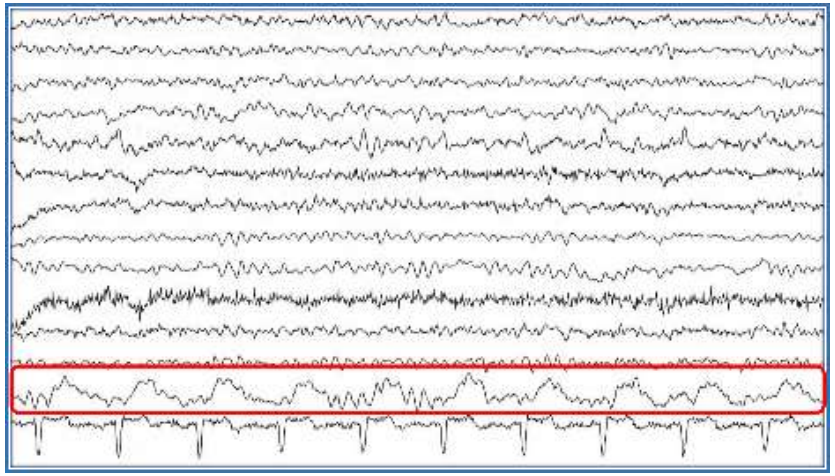
- Mechanical and Electrical
- ECG, Pacemaker - Electrical
- Pulse, Ballistocardiographic – Mechanical

✓ Mostly these are high in amplitude and prominent in babies, obese and short neck persons.

✓ Referential montages picks up cardiac artifacts.



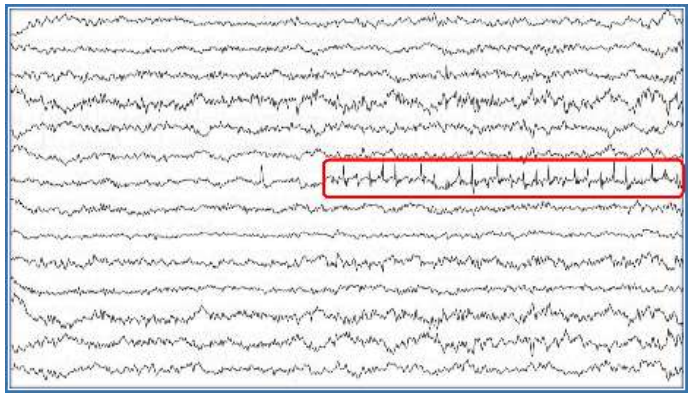
Cardiac (Electrical)



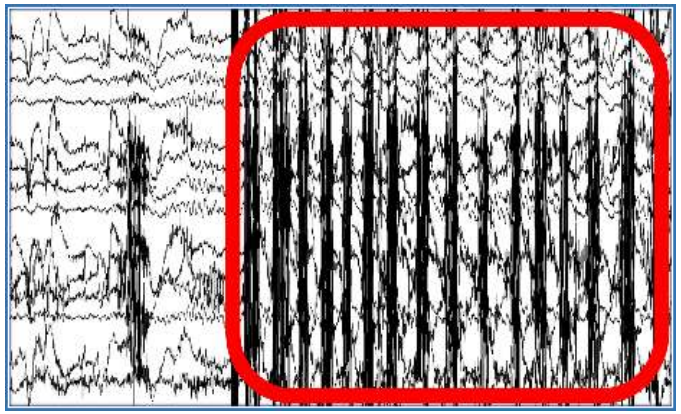
Cardiac (Mechanical)

Muscle Artifacts

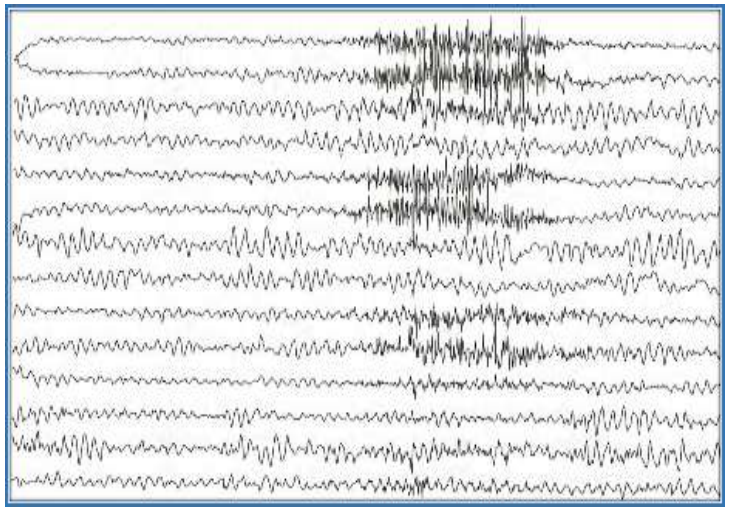
- ✓ Glossokenetic (related to tongue movements, Chew and swallow)
- ✓ Photomyogenic/ Photo-myoclonic (When flash of light falls over the face, the activity occurs due to myoclonus of the facial muscles).
- ✓ Surface EMG (Electromyography) – used to measure electrical activity during muscle contractions and relaxation cycles.



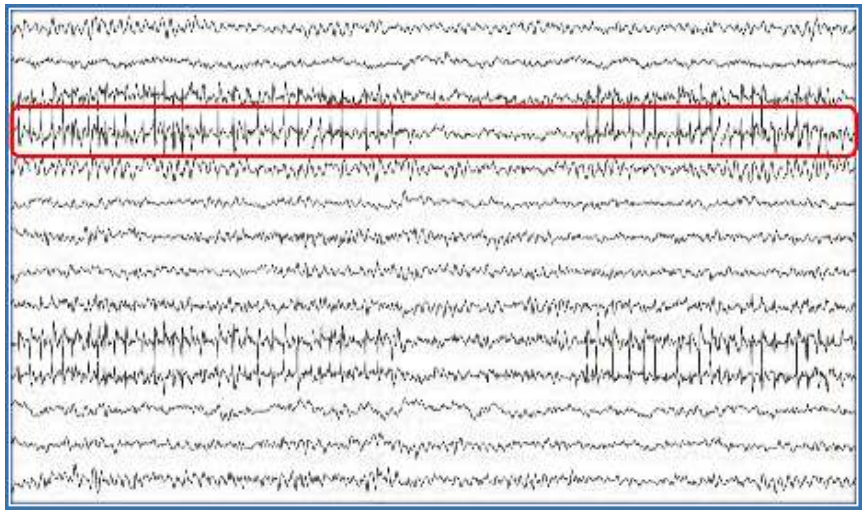
Photomyogenic



Chewing



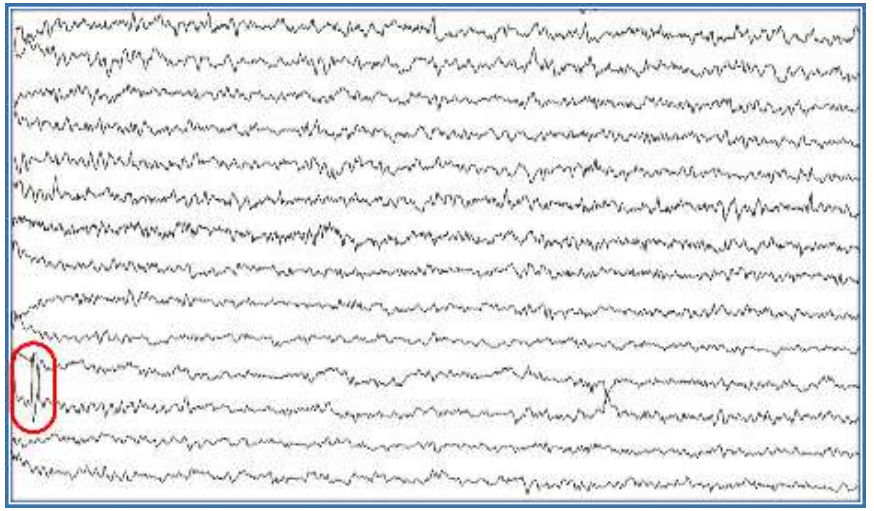
Electromyography (Scalp)



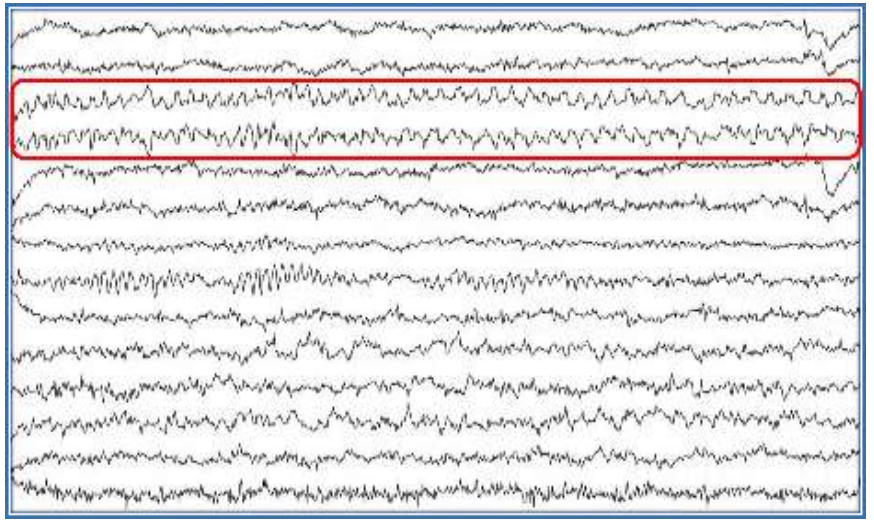
Electromyography (Facial)

Electrode and Equipment Artifacts

- ✓ Electrode pop, electrode contact, electrode movement
- ✓ Perspiration – the process of sweating
- ✓ salt bridge – differs from perspiration by low amplitude.
- ✓ Movement artifacts - Movement of head, body and limbs produce irregular high voltage potentials
- ✓ 50/60 Hz ambient electrical noise.
- ✓ Ventilators, circulatory pumps.
- ✓ Telephone, mobile.



Electrode Pop



Electrode Movement

Electrode and Equipment Artifacts

- Seen due to smearing of the electrode paste between electrodes or presence of perspiration across the scalp
- Forms an unwanted electrical connection between the electrodes forming a channel

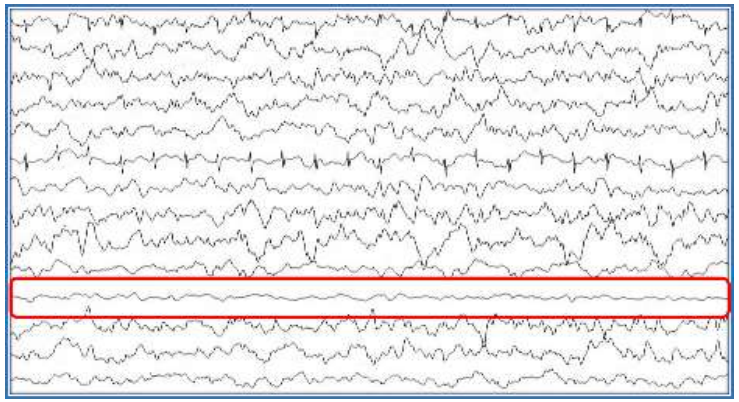
✓Perspiration artifact

- manifests as low amplitude
- undulating (smooth) waves
- duration is typically greater than 2 sec

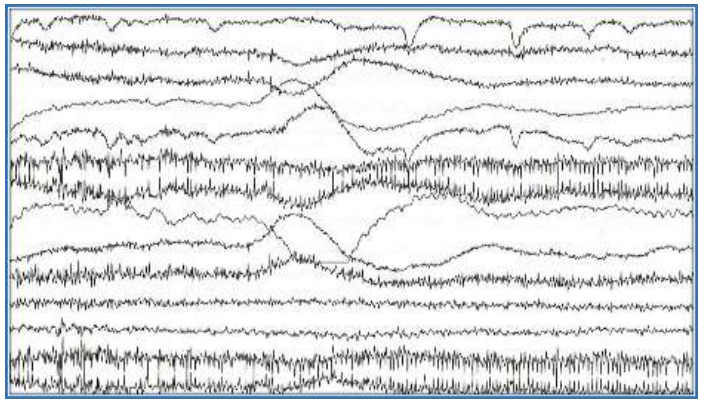
✓Slat bridge artifact

- lower in amplitude
- not wavering with low frequency oscillation - typically include only one channel
- It may appear flat and close to isoelectric

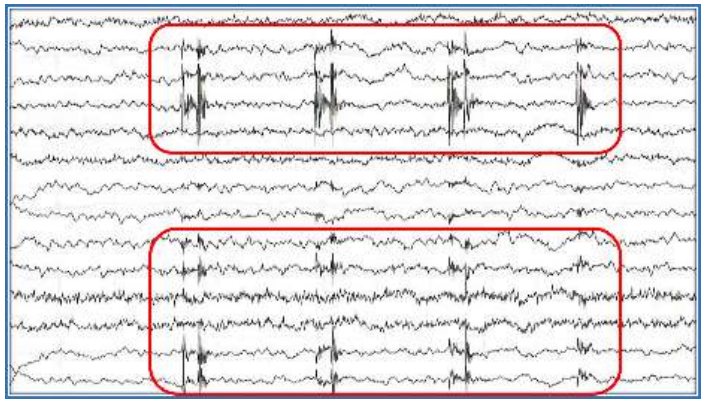
Electrode and Equipment Artifacts



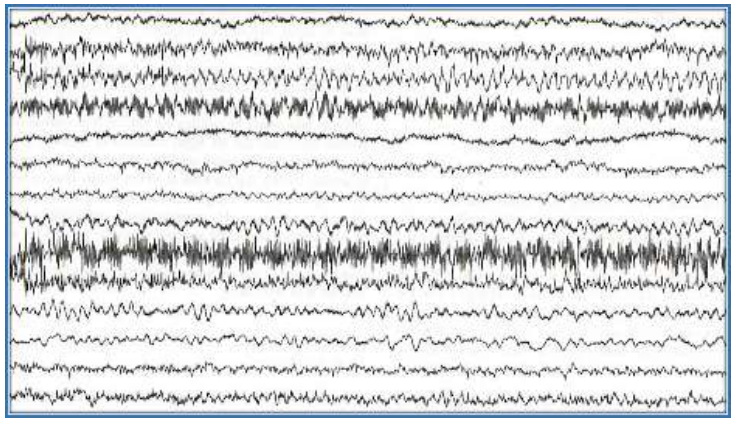
Salt Bridge



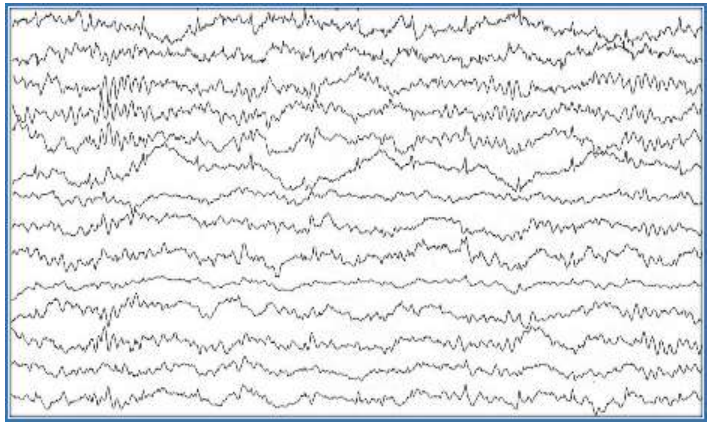
Electrode Lead Movement



Electrical Motor



60 Hz



Perspiration

Phone

Thank You!